
RELIABLE
COMPUTER
ARCHITECTURES

MURI Review
June 8, 2002

Bruce Jacob

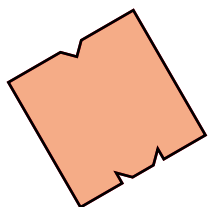
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EFFECTS OF MICROWAVES

Robust Computer Architectures

Prof. Bruce Jacob

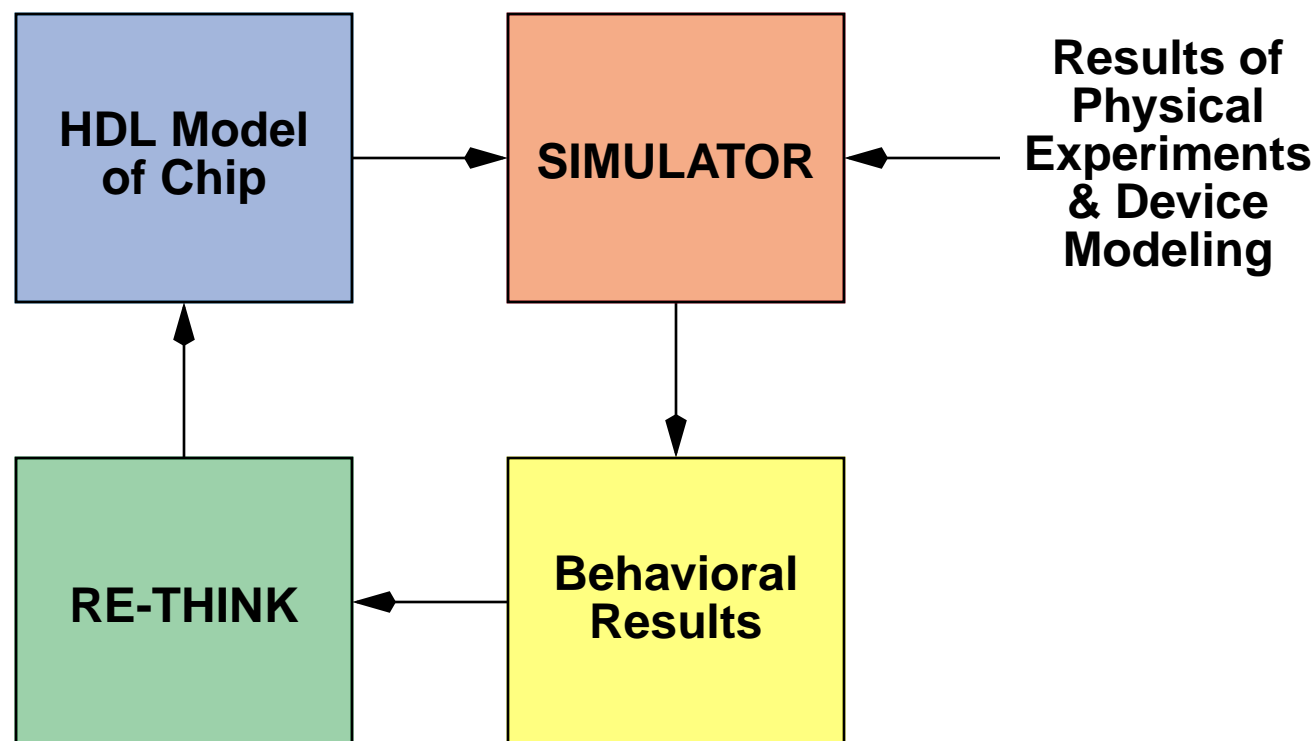
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Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE JUL 2006		2. REPORT TYPE N/A		3. DATES COVERED -	
4. TITLE AND SUBTITLE EFFECTS OF MICROWAVES Robust Computer Architectures				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Electrical & Computer Engineering University of Maryland, College Park				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES The original document contains color images.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 15	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

System Modeling



WHEN systems fail, HOW do they fail?

**We use this information
to develop & test reliable architectures**

Tasks (Talk Outline)

ACCOMPLISHED

- Verilog models of two bootable microprocessors (simple/advanced)
- Initial work on robust architectures (reliability studies, draft floorplan)

IN PROGRESS

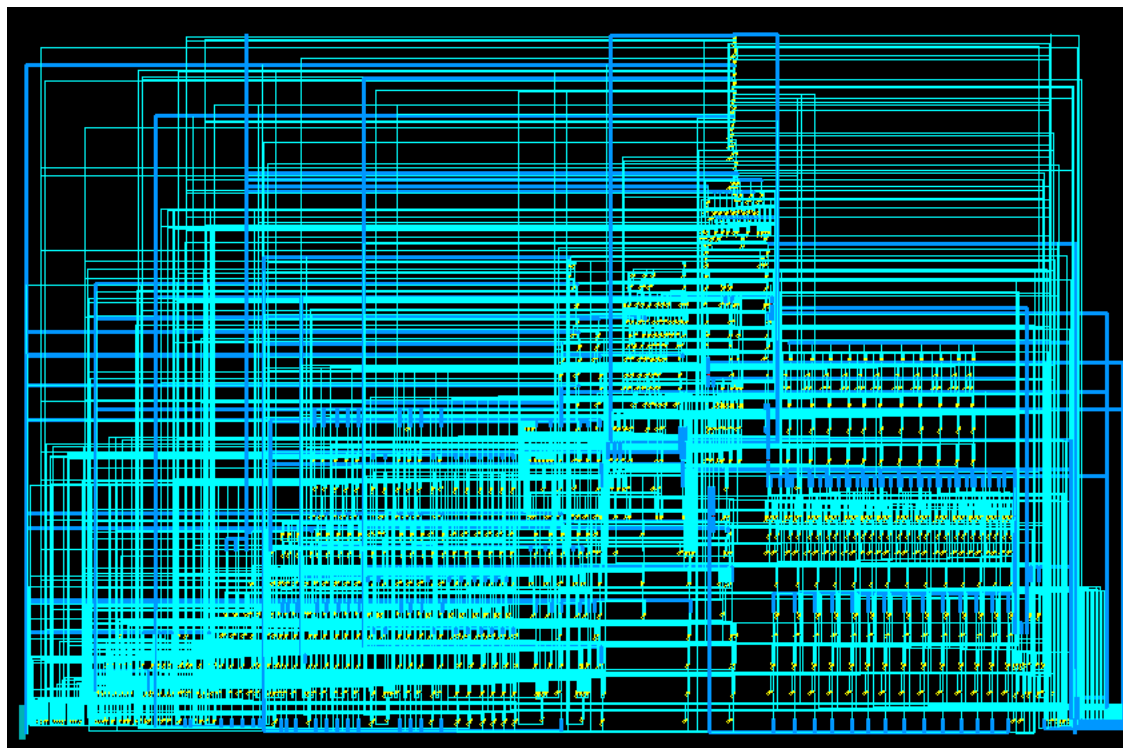
- Verilog model of microprocessor with hardware checkpoint/repair

FUTURE WORK

- Fabricate and test physical designs
- Enhanced Verilog and SPICE software

Processor Model: simple

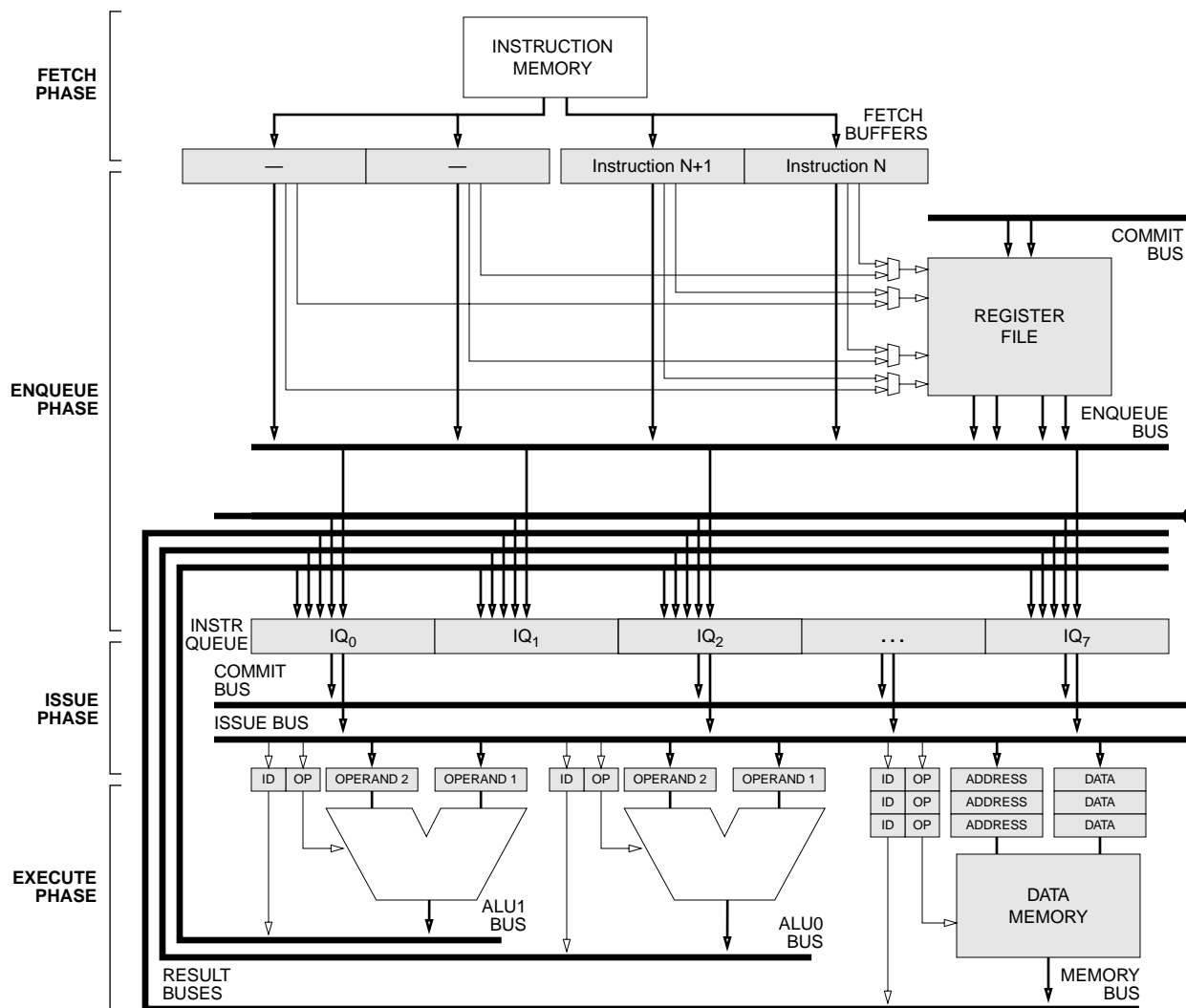
Single-Issue, In-Order, Five-Stage Pipeline



16-bit processor core
Handles interrupts precisely

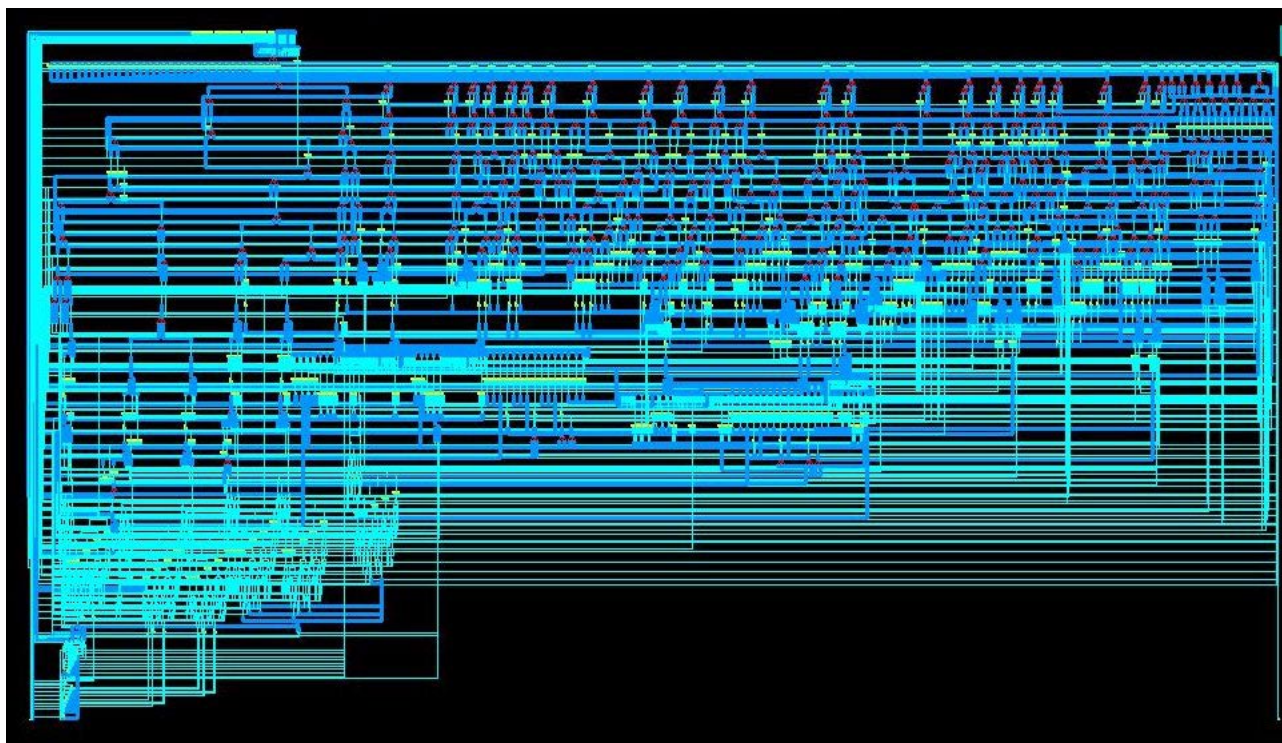
Processor Model: advanced

High-Performance Out-of-Order Core



Processor Model: advanced

PowerPC ISA with AltiVec SIMD Unit

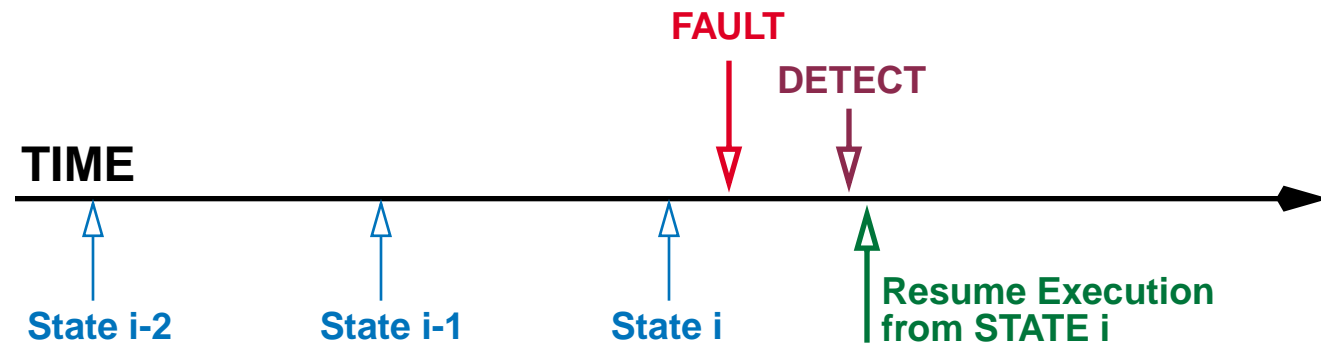


**Design & layout of core in progress
(AltiVec multiplier above)**

Robust Architectures

INITIAL STUDY: Assume the Worst Case

Checkpoint/Repair ...



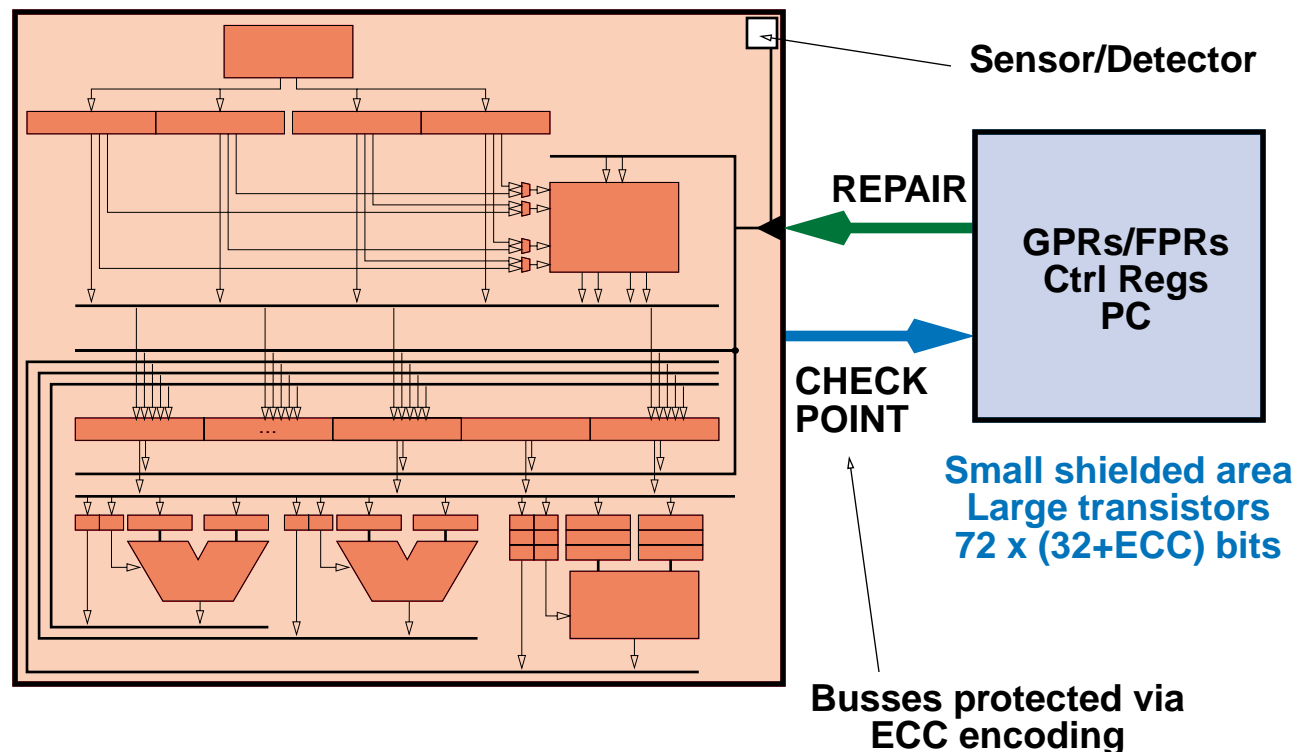
CHECKPOINT:

Periodically save KNOWN-GOOD STATE

In case of **FAULT**, **REPAIR** to last saved state

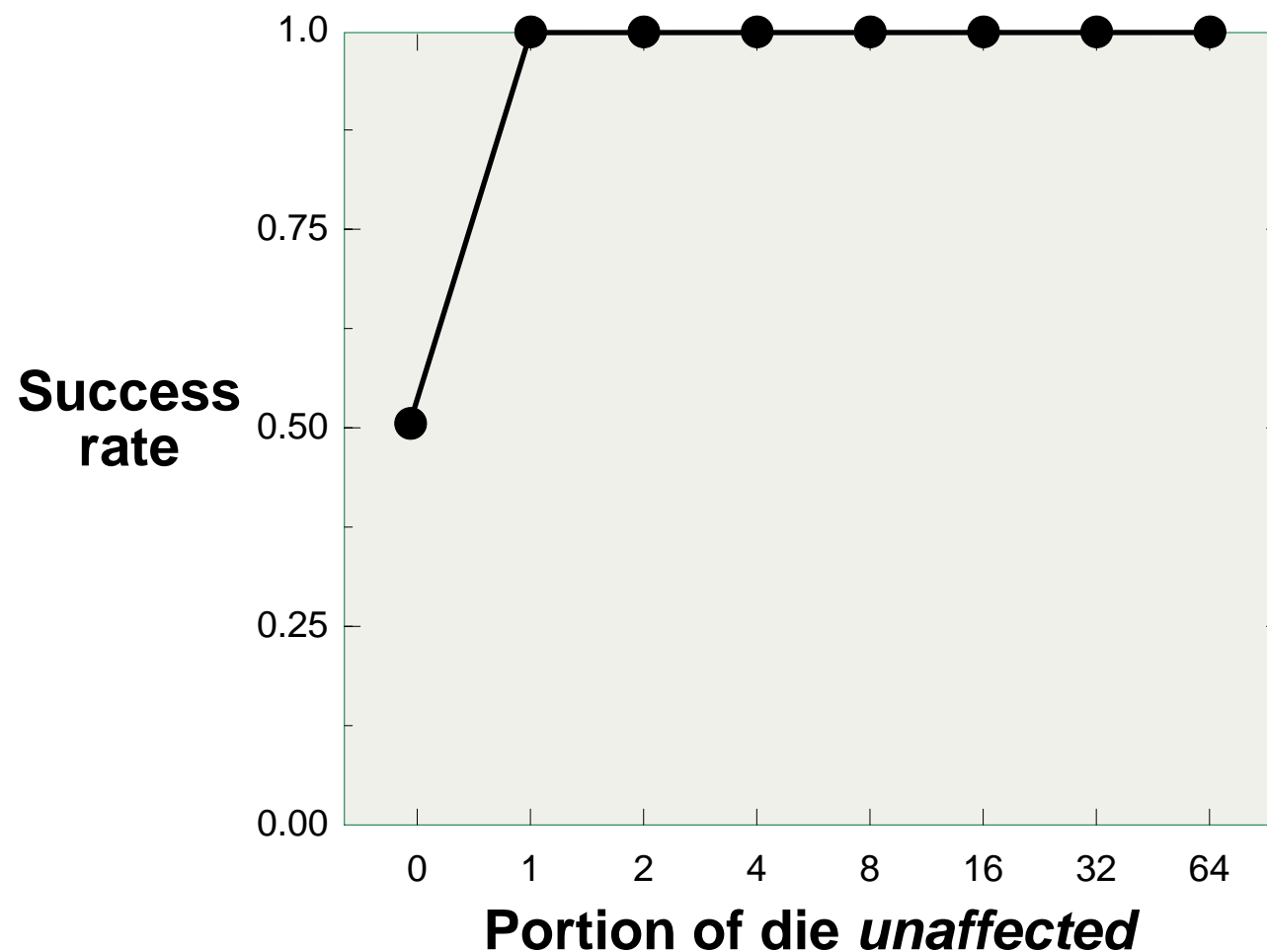
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INITIAL STUDY: Assume the Worst Case

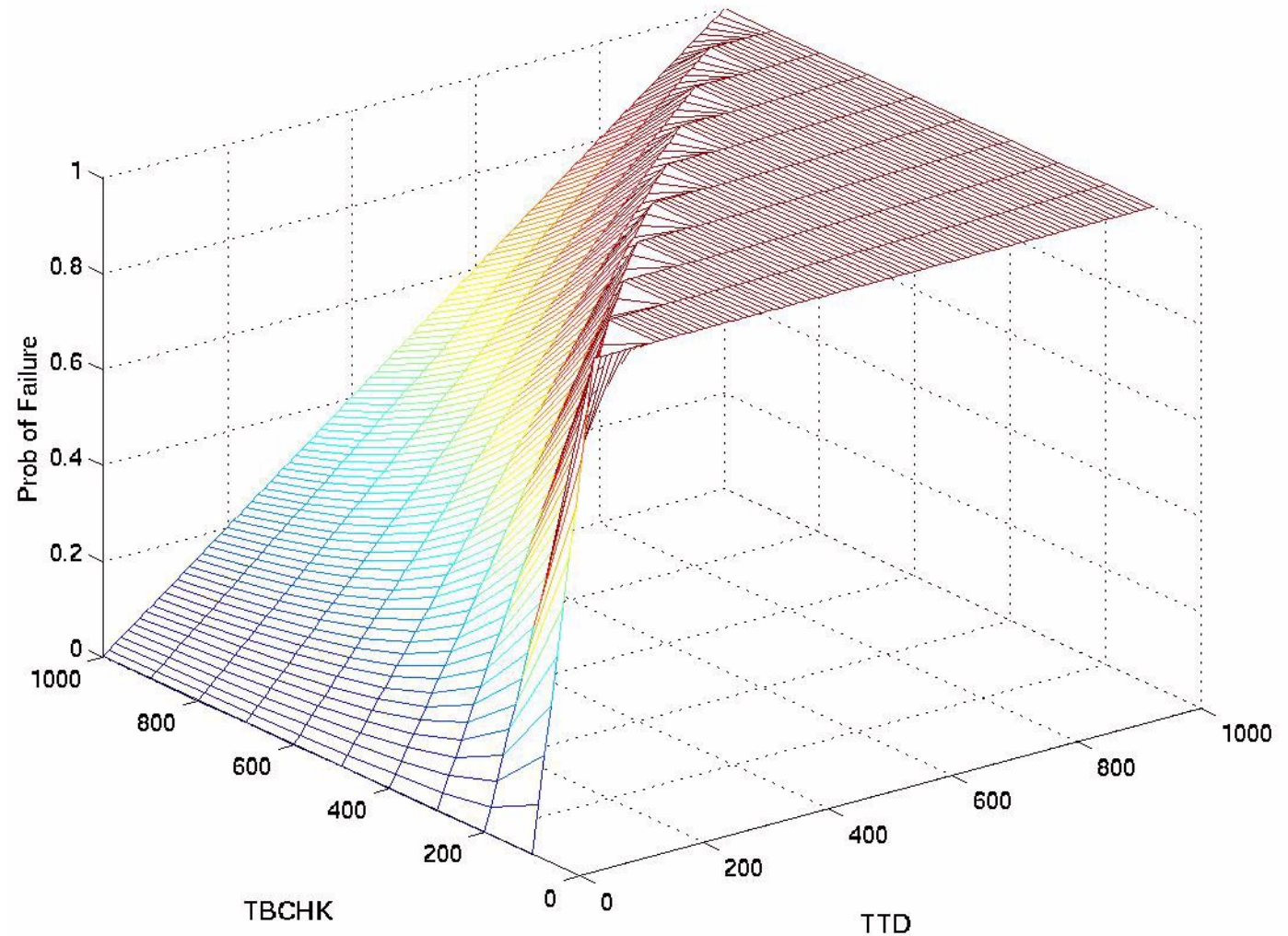


Implementation can be single- or multi-chip

Robust Architectures

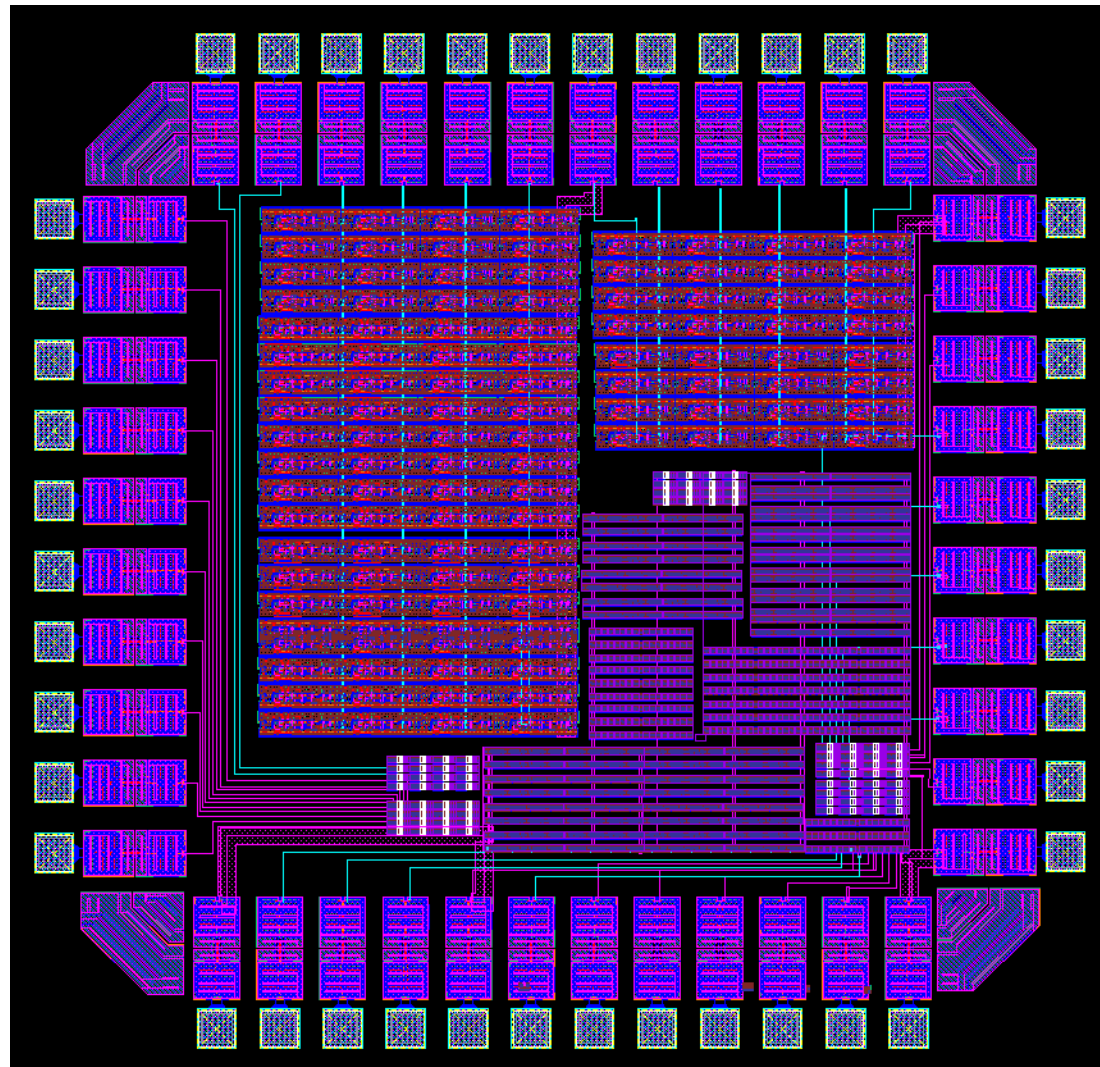


Robust Architectures



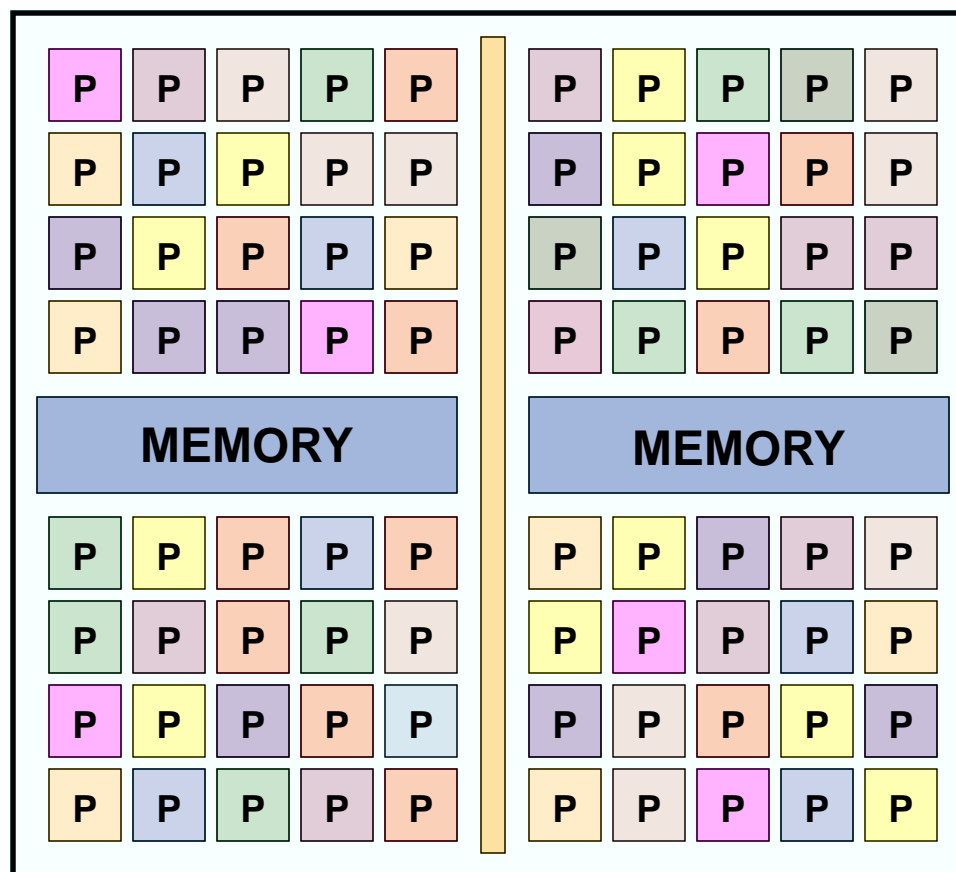
Robust Architectures

Initial Floorplan (simple CPU + safestore)



Globally Asynchronous

ASSUMPTION: Clock Net is Weak Point



**Processing elements generate local clocks
Synchronize at inter-node communication**

Future Work

Synthesize, Fabricate, Test Canonical Forms

- **Clock trees**
- **Busses (w/ and w/o ECC)**
- **Memories (w/ and w/o ECC)**
- **Arithmetic/Logic Units**

**Incorporate Drift-Diffusion into CAD tools
(more accurate SPICE/Verilog modeling)**

Participants

Profs. **Bruce Jacob & Neil Goldsman, UMCP**

A host of grad students:

- Azadeh Davoodi, Cagdas Dirik,
Amol Gole, Samuel Rodriguez,
Ohm Tuaycharoen (**Architecture**)
- Akin Akturk, Zeynep Dilli,
Tejas Chitnis (**Microelectronics**)

